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AERIAL MULTI-AXIS PLATFORM (AMP)

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Sverdrup Corporation

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Final Report

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14. ABSTRACT

Air Force ManTech accepted the challenge to provide a technology solution to the most labor-intensive tasks performed on large aircraft during depot maintenance. In collaboration with the Air Logistics Centers, they adapted a technology developed by NIST to access the aircraft safely with accurate positioning while reducing costs and flow times. Enhanced sophistication of aircraft outer mold line materials and maintenance techniques provided the basis for providing an advanced technology for large aircraft paint and de-paint operations and exterior maintenance. In March 2006, the proof of concept demonstrated a remarkable fifteen times increase in strip rate at WR-ALC. The demonstration was so successful that currently four coating removal AMP units are in use in the new large aircraft depaint hangar. The flexibility of the system immediately earned widespread interest such that OC-ALC has installed their first AMP in building 3001 to support and improve their structural repair operations with additional systems being considered. The goal is to implement, in a production environment, the basic technology, the Stewart Platform, and its adaptability and flexibility to improve processes to reduce damage, injuries, flow time and cost. The working AMP prototype developed by US Technology Aerospace Engineering Inc. and installed in their Macon, GA, plant, has validated the AMP flexibility.

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Technical Paper
for the Aging Aircraft Conference 2008
on
Aerial Multi-axis Platform (AMP)

Accomplishment: The Manufacturing Technology Division of the Air Force Research Laboratory's Materials and Manufacturing Directorate (AFRL/RXM), teaming with U.S. Technology Corporation, developed and is currently implementing a revolutionary, low-cost and highly effective aerial-based, semi-automated system to perform Maintenance, Repair & Overhaul (MRO). The Aerial Multi-axis Platform (AMP) system successfully integrates coordinated control technology developed at the National Institute of Standards and Technology (NIST) with advanced Plastic Media Blast (PMB) de-painting concepts to provide the depot community with a simple and reliable alternative to access large aircraft surfaces, such as found on C-17, C-130, C-5, and the KC-135 aircraft. This program provides a functional, production-hardened aerial platform for de-paint environments and it provides an operator-controlled de-paint manipulator with multiple nozzles that will perform PMB paint removal from an aerial work station. This concept also allows efficient access to aircraft surfaces with much less ground clutter.

Payoff: The system's ergonomically-friendly operator interface provides repeatable control of the stripping system to reduce collisions and minimize injuries. This is partially accomplished by significantly reducing operator stress and fatigue; in fact it is estimated to be reduced by over 70 percent. AMP decreases blasting time for paint removal on an aircraft by optimizing labor and maximizing worker efficiency. The AMP program design reduces depot de-paint flow time by approximately 40 percent on the surfaces it strips. The can be as much as four days on a C-5 aircraft. The process improvement eliminates ground-based scaffolding and other inefficient clutter by providing above-the-ground access during all phases of aircraft depaint operations.

The program has gone through many improvements to make this system user friendly, reliable, supportable and safe. Improved, heavy duty, off-the-shelf winch motors are located above the aerial system on a bridge type crane structure and it provides a man-rated lifting capacity with a safety factor that exceeds OSHA requirements. The system can safely lift approximately 3,400 lbs. Meeting OSHA safety requirements for crane applications.

Background: Aircraft coating removal is the most labor intensive effort performed in aircraft maintenance depots. Large aircraft are stripped about every six years. It has been estimated to require de-painting the tops and sides of all current large Air Force aircraft approximately 2,000 days and 22,000 man-hours annually. Aircraft access during

depot maintenance is difficult and the physical demands in a toxic environment are a significant source of worker's compensation and turnover.

One of the current de-painting processes abrasively removes the coating system using soda and water under high pressure through reinforced hoses. De-painters access the diversified patterns of aircraft surface by positioning intricate scaffolding and telescoping cranes that require increased time for setup, movement and disassembly. Existing ground-based equipment is difficult to maneuver accurately, especially at elevated locations like around the top of an aircraft tail, resulting in uncoordinated motions and frequent collisions and a cadre of other problems. Lengthy setup time delays the productive portions of the de-paint process, hazardous ground clutter hinders efficient access to aircraft, and a laborious stripping process adds to the cost and flow time to de-paint the aircraft. These factors result in operator fatigue and injury with lost labor hours that have been estimated to average one lost hour per shift. These processes cause excessive deterioration to aircraft skins from nozzle over-dwell time and repetitive re-accomplishment over areas that have already been stripped.

Protective clothing currently worn by de-paint technicians resembles a space suit, making movement difficult. Wearing these suits in the heat and humidity, especially at Warner Robins Air Logistics Center (ALC) and at Oklahoma City ALC, creates an even more labor intensive work environment. The workers are required to take frequent breaks to prevent heat stroke and injury from exhaustion. The PMB stripping process equipped with a single round nozzle, held by a technician for manual blasting, strips approximately one square foot per minute (depends on mil thickness). The ManTech AMP system provides an atmosphere-controlled, enclosed cab, and a comfortable operator seat with ergonomic interfaces to reduce fatigue and environmental issues. The off-the-shelf technology of Allen Bradley controls has made the control and operation of the system user friendly. The AMP system features a laser standoff sensor and four ganged fan nozzles suspended by a Stewart Platform concept to provide impressive lateral stability. The production prototype ManTech AMP has demonstrated an average strip rate of 14 square feet per minute and up to 20 square feet are feasible depending on paint thickness. A single operator can comfortably work an eight-hour shift with the de-paint module requiring less frequent breaks needed with other current de-painting processes. This increased strip rate and ease of operation are the heart of AMP's appeal.

Four AMP de-paint systems are being installed at Warner Robins ALC to support their C-5 and C-130 coating removal workload. A second configuration using modified technology with an aerial work platform optimized for lifting has been installed at Oklahoma City ALC during FY07 to support their depot maintenance workload. The aerial hoists accurately position parts and equipment and other items from the ground to remote portions of the aircraft for critical maintenance tasks.